Otis (F. N.)

A

SIMPLIFIED EVACUATOR

FOR THE

REMOVAL OF DÉBRIS FROM THE BLADDER AFTER LITHOTRITY.

(Read before the NEW YORK ACADEMY OF MEDICINE, November 1, 1883.)

BY

F. N. OTIS, M.D.,

CLINICAL PROFESSOR OF GENITO-URINARY DISEASES, IN THE COLLEGE OF PHYSICIANS AND SURGEONS, ETC., NEW YORK; SURGEON TO CHARITY HOSPITAL, ETC.

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Also, by the same Author, "STRICTURE OF THE MALE URETHRA—ITS RADICAL CURE." G. P. Putnam's Sons, Second Edition 1880. 300 pages. $3.00.

Also, by the same, "PRACTICAL CLINICAL LESSONS ON SYPHILIS AND THE GENITO-URINARY DISEASES." 8vo. 600 pages, cloth, $4.50. Bermingham & Co., 28 Union Sq., 1883.

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THE revolution which has occurred, in the mode of removing stone from the bladder, within the last five years, may now be said to be complete. The new method, first put into practice by Professor Bigelow, of Boston, whereby, as a rule, stones of any size and degree of hardness may be removed at a single sitting, has been formally and explicitly accepted, by the leading authorities, in Europe and America, as an illustrious advance in genito-urinary surgery, and has found successful imitators and enthusiastic advocates in every country. In presenting this new method, at the meeting of the International Medical Congress, held at London, England, in 1881, Dr. Bigelow briefly reviewed the methods previously in use, and as briefly alluded to his own. He said, "From the days of Civiale, to the year 1878, there was little change in the operation. The duration of a sitting, was as brief as the skill of the surgeon, stimulated by the fear of producing cystitis, could make it. Three minutes, or less, was the limit inculcated by standard books, and the teaching of specialists, and the use of anæsthesia was exceptional. At present, anæsthetics are the rule. The instruments have been already modified, in an important manner, while the sittings often last half an hour, and have been successfully extended to three hours and more." In explaining the manner in which these important changes had been brought about, Professor Bigelow referred to the first instrument devised for the rapid evacuation of stone from the bladder, after crushing. This was the invention of Sir Philip Crampton, in 1846. The apparatus consisted of a glass receiver, in form and size like a large soda-water bottle, from which, by means of an exhausting syringe, he removed the air, and then applied it to a silver evacuating catheter, previously introduced into the bladder, into the cavity of which, some ten or twelve ounces of water

had been previously injected. On turning the tap, attached to the receiver, a powerful rush of water and calculous débris, through the catheter, took place. "This," says Sir Henry Thompson, "was found to be dangerously rough in its action and required to be so repeatedly charged that I desisted from its use."

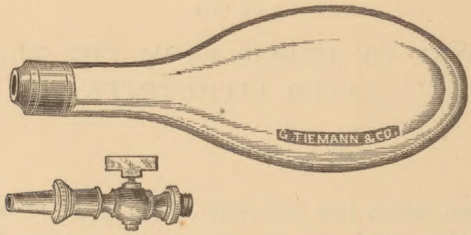

FIG. 1.—Sir Philip Crampton's Evacuator.

This instrument was modified by Mr. Clover, of London, who substituted, for the glass receiver and the exhausting syringe, an india-rubber bottle placed behind a glass receiver. On compression of the elastic bottle, the necessary vacuum was formed, and the débris was deposited gently into the receiver. The first form of the receiver was a simple cylinder of glass, as in the accompanying cut, Fig. 2.

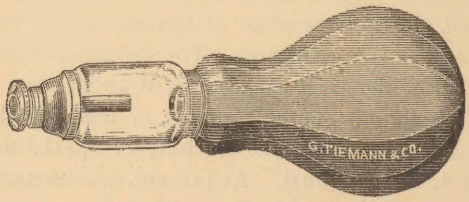

FIG. 2.—Mr. Clover's First Evacuator.

This instrument was subsequently modified by the addition of a vertical glass chamber for the prevention of a return of the débris into the bladder. (See Fig. 3.)

Professor Bigelow pays a merited tribute to Mr. Clover, whose instrument for evacuating calculous material from the bladder, after lithotrity, was the only one of practical value previous to his own.

He says, "Had Clover, whose catheter had a calibre of only 21 of the French standard (about 12 English), or Mercier, employed larger catheters (between 25 and 31 French—15 to 20 English) *they might*

have evacuated the bladder completely! They would have found how little affected it was by a long operation, if no fragments were left behind, and that polished instruments were not injurious, while sharp

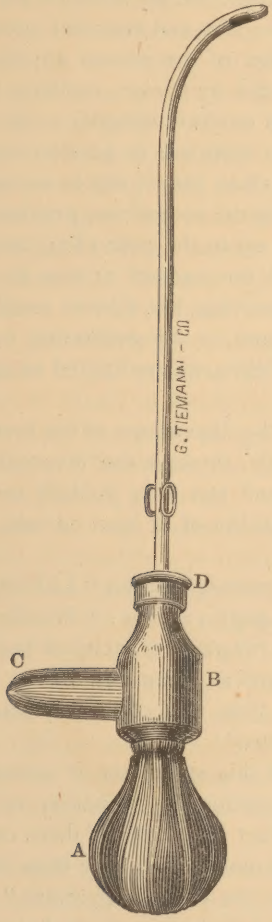

FIG. 3.—Clover's Improved Evacuator. A, india-rubber air-chamber; B, glass receiver; C, tube projecting into receiver; D, junction between evacuating catheter and suction apparatus. Size of evacuating catheter 12—English—equal to 21 mm. in circumference.

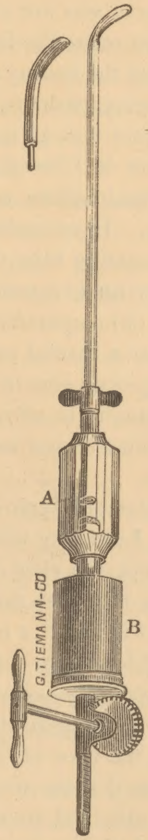

FIG. 4.—The French Evacuator. A, the air-chamber; B, the piston worked by rack and pinion.

fragments were. They would have discovered a tolerance, on the part of the bladder, wholly at variance with the traditions of half a century. Upon this tolerance modern lithotrity is based.

"*The new and essential instrument, is the large catheter* (25 to 31), whether straight or curved. *This is indispensable.*" Then follows a description of the evacuator of Professor Bigelow. It will at once be seen that there is an important hiatus, between the old, inefficient instrument of Clover, and "the new and essential instrument" of Bigelow, and that is, an explanation of the reason why the larger instrument was not constructed and used by Clover, and thus have secured, at once, the later advantages of modern lithotrity. In order to complete the history of this important advance in genito-urinary surgery, I may, perhaps, be permitted to state, that it was in consequence of the fact that all anatomical and surgical authorities, previous to the invention of Clover's evacuator, and up to the year 1874, taught that the normal calibre of the urethra did not exceed 21 mm. in circumference. In accordance with that teaching, Mr. Clover *could not use* an evacuating tube of more than 21 mm. in circumference, hence, its capacity for evacuation of calculous débris, was so limited as to render its use of comparatively little value.

After a careful practical study of the dimensions of the urethra, extending over several years, and finally, through the invention of the urethrametre in 1874, I discovered, and was able publicly to demonstrate, an average normal urethral calibre of at least 32 mm. circumference.

Professor Bigelow, in his earliest monograph on "Litholapaxy, or Rapid Lithotrity with Evacuation,"[1] page 11, says: "Whether or not we adopt the view of Otis, that the average capacity of the normal urethra is about thirty-three of Charrière, there can be no question that it will admit a much larger tube than that commonly attached to either Clover's or the French apparatus."

While fully accepting the truth of this statement, it seems to me proper to suggest that, it is not a question of "Whether or not we accept the view of Otis," etc. The fact stated, that "there can be no question that the urethra will admit a much larger tube than that commonly attached to either Clover's or the French apparatus," *was not established nor claimed*, prior to my demonstrations in America and Europe in 1874 and 1875.[2]

Dr. Bigelow, in his paper before the International Congress, previously alluded to, thus vigorously states the result of a failure to ap-

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[1] Boston: A. Williams & Co. New York: Wm. Wood & Co. 1878.

[2] See Otis on Stricture of the Male Urethra. Second Edition, pp. 25, 72, 89, 97, 183 et seq. New York: Putnam's Sons, 1880. And a Table of Measurements of One Hundred Supposed Normal Urethræ, p. 200 et seq. 1875.

preciate the true or normal calibre of the male urethra. There he says: "*The small size of the previous evacuating catheters delayed surgical progress for nearly half a century.*"

By thus explaining why the use of an evacuating tube from 25 to 32 mm. in circumference, was not adopted by Clover and Mercier, the hiatus in the history of this important advance in surgery, previously alluded to, is completely filled.

Professor Bigelow, in his report to the International Congress, modestly disclaimed any credit in the operation, except in the use of the large evacuating tube, and assumed that Clover and Mercier, certainly would have discovered the tolerance on the part of the bladder, upon which he claims "modern lithotrity is based."[1]

It is true, that Professor Bigelow did not discover the tolerance of the bladder to instrumental interference. This was previously well known. On March 3, 1876, and thus over two years previous to the publication of his brochure on "Litholapaxy," I was called upon by Dr. Fred. P. Mann, of Brooklyn, to remove a calculus from the bladder of a lady sixty-four years of age. With the assistance of my associate Dr. Bangs, and Dr. Mann, the urethra, which easily admitted 30 under ether, was dilated up to 45. A forceps was introduced, the stone (a phosphatic one) was crushed, and the débris washed out with Clover's apparatus attached to a 30 silver, open-end, evacuating tube. On subsequently examining the walls of the bladder with the finger, they were found coated with calculous material, which, by the aid of a scoop, my finger, and repeated washings, I was enabled completely to remove. The time, during which the bladder was subjected to this necessary procedure, was just one hour and ten minutes.

The patient rallied quickly from the anæsthesia; the operation was not followed by the slightest constitutional disturbance, and she made a perfect recovery, and is at the present writing alive and in good health.

November 6, 1877, I was called to Sag Harbor to see a case of supposed urethral stricture with ulceration of the bladder. The patient had been confined to his bed for more than a year. On examination, I found a stone in the bladder, and operating by Dolbeau's method I passed a forceps through the perineal opening, crushed and removed a calculus, the débris of which, filled a large goblet. The calculus was so large, that I was nearly an hour in crushing off the sides of the stone, before it could be brought fairly within the jaws of the forceps. After

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[1] Trans. Int. Cong., vol. ii., p. 293.

this, the operation was speedily finished, but, with the necessary instrumental interference within the bladder, and the subsequent manipulations for cleansing it, from the commencement of the crushing, to complete evacuation, the time was an hour and a quarter. No local trouble resulted from this prolonged operative interference within the bladder. The patient made a perfectly satisfactory recovery under the care of Dr. Rodgers, of Sag Harbor.

I am sure that many surgeons have experiences, practically equivalent to the foregoing, antedating the operation of litholapaxy by many years. And thus I claim, that Professor Bigelow did not *discover* the tolerance of the human bladder to prolonged instrumental interference. *He did much more*—he utilized the knowledge which he in common with other surgeons possessed. He had the inspiration to conceive of its value as a factor in a great life-saving operation. He seized the demonstration of an average urethral calibre of 32 mm. in circumference. He joined it with his knowledge of the toleration of the bladder to legitimate surgical procedures, and *litholapaxy* was born. He had the courage, the surgical knowledge, the skill, the inventive mechanical genius, and the perseverance to carry it, *vi et armis*, to a successful maturity, *thus finally achieving one of the most brilliant surgical triumphs of modern times.*

The size of the evacuating tube has been shown by Professor Bigelow to be the most important factor in the operation of litholapaxy. The smallest calibre to be really efficient and satisfactory may be fixed at 27 F., and the largest affording all desirable facility in evacuating the débris may be fixed at 32 F., which is less than the average normal calibre of the urethra by over one millimetre.

In a normal urethra, that is to say, one free from localized contractions or obstructions, it may be assumed that an evacuating tube of proper shape and corresponding size may, as a rule, be easily and safely passed through it, into the bladder. The normal calibre of an urethra may, in all cases, be safely assumed, from a measurement of the circumference of the penis.

After a careful experience on this point, in many hundred instances, I do not hesitate to claim, that the relation of the size of the urethra to the size of the penis, in any given case, is invariable, and that any variation from it is abnormal. I have never yet met with a single case, where the estimate of the calibre of a urethra, based upon this proportionate relation, has proved excessive.

This relation was formulated by me, in a table presented to the profession in 1875, as follows :

CIRCUMFERENCE MIDWAY OF THE PENIS.

Of Penis.	Of Urethra.
3 inches, or 75 mm	30 mm., or more.
3¼ " " 81 mm	32 mm., "
3½ " " 87 mm.	34 mm., "
3¾ " " 93 mm.	36 mm., "
4 " " 100 mm.	38 mm., "
4¼ to 4½ " 105 to 112 mm.	40 mm., "

Now, while I have seen many cases, where the urethra was larger than that claimed in the foregoing table, I have never seen a single case where it was less. Whenever a full-sized instrument, selected in accordance with the proportionate relation, above claimed, did not easily traverse the urethra, then, the failure was always shown to be due, to localized contractions, either at the meatus, as the result of malformation, or pathological causes, or from easily recognized stricture at some deeper point in the canal. Obstructions resulting from prostatic enlargement should always be respected, and in such cases *the smallest tube which will be efficient in removing the débris* should be used. This, because all forcible interference with the parts thus diseased, is to be avoided as much as is possible. All localized contractions of the urethra, should be removed before the operation of litholapaxy. Contractions at the meatus, should be divided, and allowed to heal, before operation for litholapaxy. The chief dangers of litholapaxy, reside in the injuries to the deep urethra, during the operation—hence the urethra should be put in the best possible condition, throughout, before the operation is attempted. Time should always be allowed for complete healing of the wounds resulting from preliminary division of the meatus, or of deeper contractions, before the operation of litholapaxy is attempted. In this way any hemorrhage, resulting during the operation, will be referred to its real cause, and the operator will be relieved from the embarrassment of a hemorrhage from the urethra, resulting from division of the meatus, or deeper stricture, at the time of operation, which could not then be quickly differentiated from hemorrhage produced by injury of the bladder, in the process of crushing. Civiale was in the habit of dividing the meatus and allowing the wound to heal, before attempting the operation of crushing the stone. In this way he discovered that many reflex irritations, simulating stone in the bladder, were due to the contraction of the meatus alone. Having, then, thoroughly cleared the urethra from all localized contractions, the operation of litholapaxy may be approached, with the greatest security against embarrassment from mechanical obstruction in the urethra.

The facility, and safety, with which the operation of removing the débris from the bladder, in litholapaxy, depends, in a very important degree, on the size and shape of the evacuating tube or catheter. Professor Bigelow recommends that the size shall not be below 25 mm. in circumference, nor above 31 mm. For my own part I have never yet met with a normal adult urethra of less than 28 mm. in circumference. Whenever, therefore, the urethra will not admit an evacuating tube of 26 or 27 mm. in circumference, I do not hesitate to claim that stricture is present, either at the meatus, or at some deeper point, and, after verifying this claim by examination, to recommend restoration of the canal, by removal of the contractions by dilatation or by division, before operating, rather than to use an evacuating tube of a smaller size.

The difference of even 2 or 3 mm. in the size of an evacuating tube, when below 30 mm. in circumference, makes an astonishing difference in its evacuating capacity. For instance, in using the evacuating tube 30 mm. in circumference, twenty pressures of the bulb, of my new evacuator (Fig. 12, page 18) at intervals of one and a half second, withdrew from the glass bottle (representing the bladder) and deposited in the receiver, 300 grains of crushed coral, which is almost identical in weight and mode of cleavage with mixed calculi. Whereas, under the same circumstances, with the same number of pressures of the bulb, and in exactly the same time, with an evacuating tube of 27 mm. circumference only 180 grains were deposited in the receiver. It may, I think, be confidently stated that in the absence of stricture, or congenital contraction of the meatus, or of prostatic enlargement, an evacuating tube, two or three sizes smaller than the normal urethra, according to estimate previously stated, may, as a rule, be easily and safely used.

Professor Bigelow uses, and recommends, the straight evacuating tube, in preference to the curved. The calculous débris finds its way through it, much more directly and easily, and while less liable to become clogged, it is more readily cleared. The only objection appears to be, the somewhat greater difficulty of introducing it into the bladder, especially in cases of enlargement of the prostate. I have modified the straight instrument of Professor Bigelow, by adding a small curved projection, which, with all the advantages of the former, I have found more easy of introduction, and preventing, in greater degree, the closure of the opening in the tube, from engagement of mucous membrane in it, during the process of evacuation. (See evacuating tubes in Fig. 12.)

Notwithstanding the statement of Professor Bigelow, already quoted, to the contrary, *something more than a large evacuating tube* was essential to the new operation. This was a more powerful evacuating apparatus than that of either Clover or Mercier. This lack was supplied by Professer Bigelow—thus finally enabling him to perfect his operation of "*rapid lithotrity with evacuation.*"

His first apparatus consisted, simply, in a large, strong, india-rubber bulb, furnished with a glass receiver for the débris, and a tube at the opposite extremity for attachment to the evacuating tube. (See Fig. 5.)

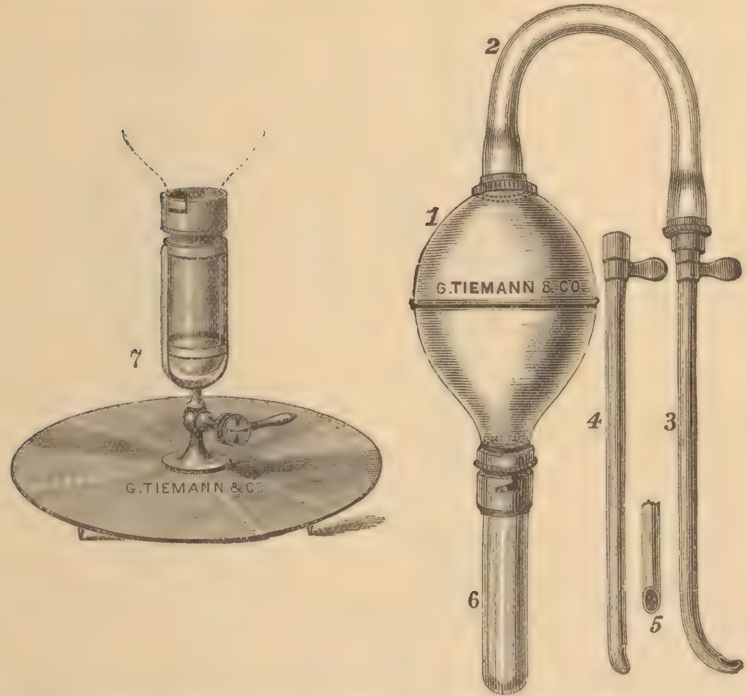

FIG. 5.—Professor Bigelow's Original Evacuator. 1, elastic bulb; 2, curved rubber tube; 3, curved evacuating tube of silver; 4, straight evacuating tube, which is preferable to the curved one; 5, front view of same; 6, glass receptacle with bayonet-joint for débris; 7, stand. (Tiemann & Co., New York.)

This instrument was found perfectly efficient and came into general use, although it was open to the objection that fragments and débris, having been once withdrawn from the bladder, were again carried back into it by the return current. There was also the real, or theoretical, complaint, that, during its use, it permitted too free access of air into the bladder.

Sir Henry Thompson, of London, who was quick to recognize the great improvement of Bigelow's method over those previously followed, adopted Bigelow's procedure, and produced, in 1879, an evacuating apparatus differing from that of Professor Bigelow, in that the débris fell from the evacuating tube, directly into the receiver or trap, and that the connection of the tube with the bulb, was rigid and metallic, instead of by rubber tubing, and was filled, previous to use, through a funnel and stop-cock at its apex, instead of through the tubing. (See Fig. 6.) Efficient in Sir Henry's hands, it was exposed to the same ob-

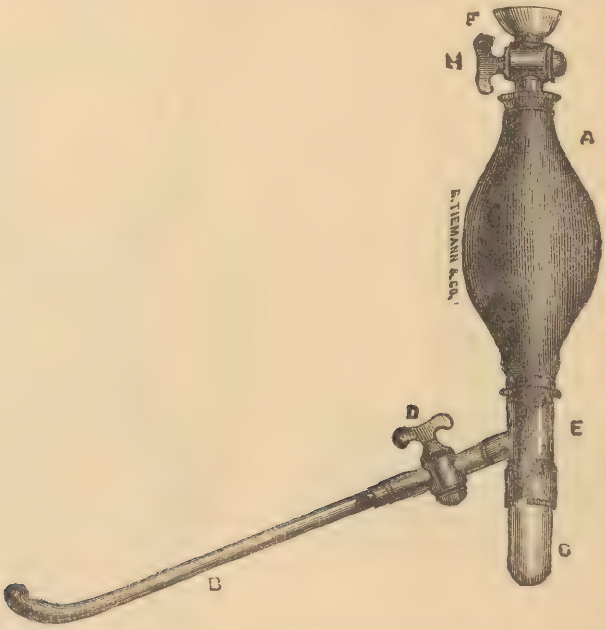

Fig. 6.—Sir Henry Thompson's Original Evacuator.

jections that had been raised against Professor Bigelow's instrument. In 1880, in the third edition of his work on "Practical Lithotomy and Lithotrity," page 186 (J. & A. Churchill, London), he presented the following modification of the apparatus (see Fig. 7), the advantages of which he claims are, that "the change in the position of the lower tap shortens the distance for the fragments to traverse, which thus reach the receiver by the shortest possible route. The current having less distance to travel, has thus more powerful action on the fragments, and consequently the aspiration is more perfectly made than it has hitherto been. The fragments enter, fall downward through the tube, *and can-*

not mount again into the apparatus, in consequence of the projection of the tube into the glass receiver." He also says, "for those who prefer a portion of flexible tube between the aspirator and the evacuating catheter[1] two inches thus interposed will insure freedom from any jar to the bladder in using the instrument, and will only lengthen the route *pro tanto*." "For myself," he concludes, "I prefer the absolutely direct and shortest route, having no more fear of hurting the bladder, with the inflexible evacuating catheter, than I have with the inflexible lithotrite."

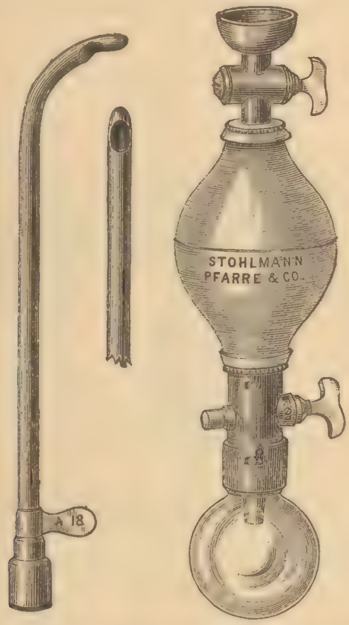

FIG. 7.—Sir Henry Thompson's Improved Evacuator, showing the mechanism of the taps *through* which the débris passes to the glass receiver.

Up to this point the evacuator of the great English lithotritist, appeared to possess the advantage over his American rival, in the more direct route for the débris, while the greater freedom from angles on this route (see Fig. 5, page 11) seemed to promise at least equal efficiency for the latter.

Practically I had made use of Professor Bigelow's original instrument from an early date, with complete success in every instance, and without finding anything in its working, which appeared to de-

[1] As in Professor Bigelow's original evacuator.

crease its efficiency, in any marked degree. Of it, as late as April, 1883, Mr. Harrison, of Liverpool, in his valuable brochure on lithotomy, lithotrity, etc., writes of Professor Bigelow's evacuator thus: "After trying several modifications of it, I must express my satisfaction, so far, *with the original instrument*" (represented at page 11). He further says: "Exception has been taken to it on the grounds (1) that the trapping of the fragments is imperfect, (2) that the apparatus permits air to enter the bladder." Admitting the truth of these objections to some extent, he says: "I am not disposed to think that the utility of the instrument is thereby seriously impaired."

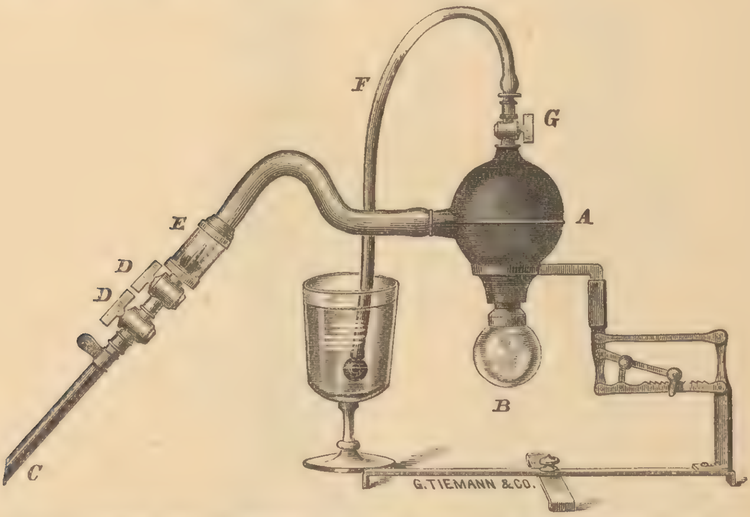

FIG. 8.—Professor Bigelow's Evacuator, complete. Curves in the elastic tube make it less liable to flatten when bent. The hose is attached when it is needed. (From Bigelow, op. cit., p. 297.)

Professor Bigelow, nevertheless, began a series of experiments, with the view of increasing the excellence of his evacuator, addressed not only to excluding the air from it, during operation, but in preventing the débris from re-entering the bladder by the return current.[1]

In the improved instrument (see Fig. 8), heavy stopcocks at DD, one attached to the evacuating tube and the other to that in connection with the bulb, and subsequently a catheter valve or strainer was interposed between the latter stop-cock and the bulb; also a tube F, guarded by a stop-cock at G, for refilling the bulb, if necessary, without withdrawing the evacuating catheter from the bladder.

[1] Transactions of the International Medical Congress, 1881, vol. ii., p. 293.

This was subsequently modified by transferring the strainer to the body of the bulb and dispensing with the ball valve, as in Fig. 9.

In this, the route for débris is much shortened by the substitution of a universal joint in place of the tubing, and entering the bulb at its centre, instead of at its apex—on all these points more nearly approaching the evacuator of Sir Henry Thompson. The instrument, however, although more perfect in its working, was equally complicated and expensive. Probably for this reason Professor Bigelow continued his efforts for a perfect and more simple apparatus. These were

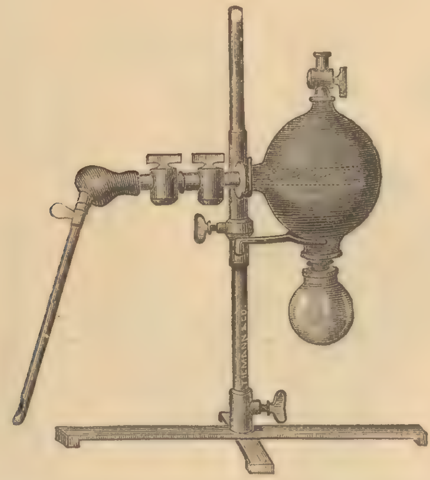

Fig. 9.—The "Simplified Evacuator" and Stand. The catheter is prolonged, by a long tubular strainer, into the bulb. This makes a catheter-valve, though still advantageous, less necessary. An elastic ball or universal joint, with a small tubular strainer, is also substituted at the head of the catheter for the elastic tube, and makes the instrument shorter. The stand is here a retort stand. The bulb hangs firmly in a fork, and can be variously inclined.

signally successful, resulting, during the early part of the present year, in the instrument represented by Fig. 10, page 16.

In this the route for the débris is again greatly shortened. The return of débris to the bladder, is prevented by the strainer, which is here prolonged into the bulb at an acute angle. The movable joint is dispensed with, and probably, for the reasons given by Sir Henry Thompson on page 13, the connection with the bulb, is without an intervening flexible tube. I have used this on a single occasion, and its operation was perfect. I felt satisfied that for this form of instrument it was the most simple, direct, and efficient in action of any that had been devised.

In the meantime, Sir Henry Thompson's improved evacuator, had

been modified, at the suggestion of Messrs. Weiss & Son, surgical cutlers, of London, in order to carry out more perfectly one of the conditions for a perfect evacuator previously insisted on by Sir Henry Thompson, viz., to secure the shortest possible route for the passage of débris from the bladder to the receiver. This modification is shown at page 17 (Fig. 11).

"This," says Sir Henry, "is identical with Fig. 4 (as represented in Fig. 7 on page 13) in every particular, except that the cylindrical

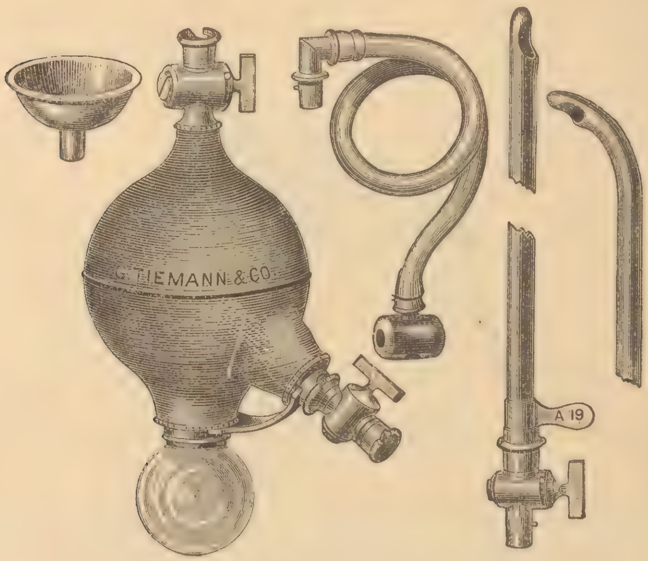

FIG. 10.—Professor Bigelow's Evacuator, improved 1883.

receiver which is in Fig. 4 (Fig. 7, page 13) directly under the bottle, and may be influenced by currents, is removed to the front of it, and is perhaps less disturbed by the current which passes over the mouth of the receiver. . . . In neither Fig. 4 (Fig. 7, page 13) nor Fig. 5 (Fig. 11, page 17) is any stand required, and the connection with the bladder, is the shortest and simplest possible." The connection of the aspirator with the bladder, is also cut off in both instruments by the taps T T.

Notwithstanding their excellence in other respects, the weight and size of the different evacuators had often occurred to me as an objection, as well as their necessary expense, a good modern instrument

costing about thirty dollars. After a careful experimental study of the matter, bearing in mind the excellent points of all the instruments in use for this purpose, the plan of a new instrument was evolved by me, and elaborated by the surgical cutlers, Messrs. George Tiemann & Co. (See Fig. 12, page 18.) It consists of a strong annealed glass bulb, A, two inches in diameter, the reservoir, into one side of which a metal tube, B, forty mm. in circumference, curving down to its lowest part, is inserted. This is connected to the evacuating catheter C by the india-rubber tube. Attached to the floor of the reservoir by a bayonet-joint, E, is a short, strong, glass bottle, F, the receiver. On the side of the bulb, opposite the tube connecting with the evacuating

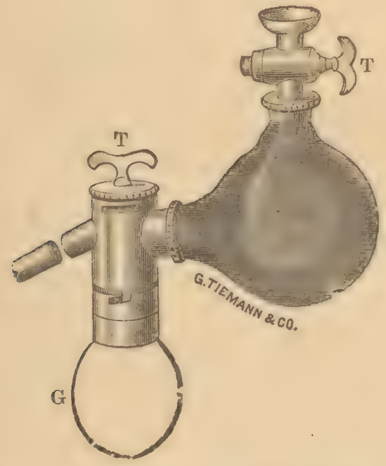

FIG. 11.—Sir Henry Thompson's latest Evacuator, modified by Weiss.

catheter, is another metal tube (at G) curving upward to near the top of the bulb A. This is connected by another flexible tube, H, with a strong india-rubber bulb, I, constituting an independent air chamber. A stop-cock at the extremity of the flexible tube, permits the removal of the catheter without leakage from the reservoir A. The capacity of the reservoir A, is just three fluid ounces, that of the receiver F, one and one-half ounce. To put the instrument in operation, it is necessary, first, to shut the stop-cock, then disconnecting the receiver F, from the reservoir A, and reversing the latter, so that its opening looks directly upward, with a small pitcher, or cup, fill it with water to the brim.

Then, with the reservoir still in the same position, attach the receiver F (see Fig. 13), return the instrument to its upright position, and it is ready to be attached to the evacuating catheter, previously introduced into the bladder. Or, the instrument, in the position shown,

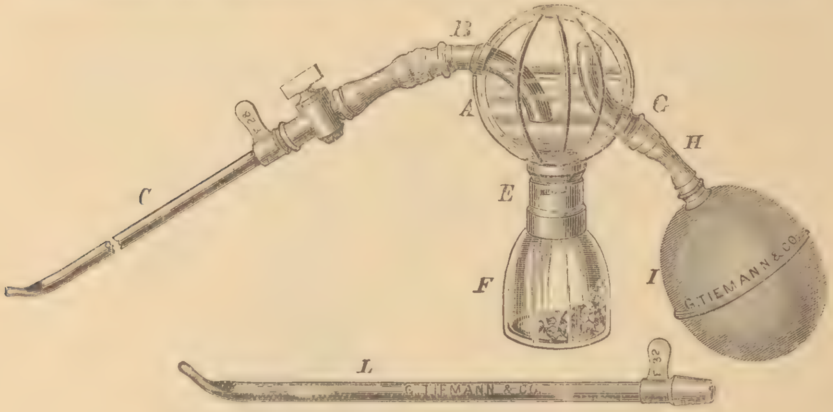

FIG. 12.—The Author's Simplified Evacuator.

may be emptied of the contained air by firm compression of the bulb I, the evacuating catheter attached and placed in a vessel containing sufficient water, when by removing the pressure the instrument fills instantly and is then ready for use. Should it become desirable, during the operation of removing the débris, to introduce more water into the bladder, this may be readily done in the following manner.

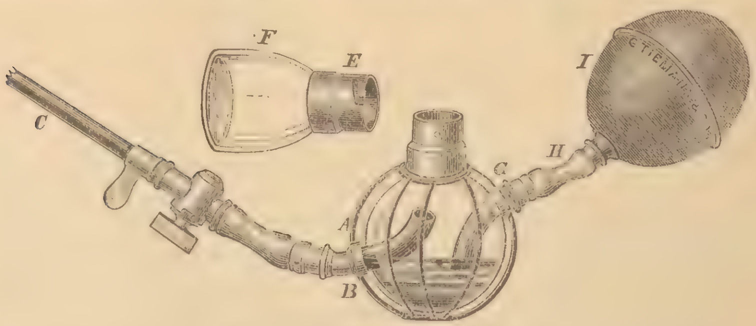

FIG. 13.—The same reversed for filling.

Reversing the instrument as above shown, by unscrewing the tube connection at B half a turn, leaving the evacuating tube undisturbed, any desired amount of water poured into the reservoir finds its way readily through the evacuating tube into the bladder. In working

the instrument, the independent air-chamber I may be unscrewed at G and filled completely with water, and the necessary vacuum produced by displacement of the water instead of air, as previously shown. Besides the trouble attendant upon filling the air-chamber with water, the only apparent objection is that it adds unnecessary weight to the instrument. The only advantage is that it gives the greatest security against the introduction of air into the bladder. It is, however, quite certain that the small amount of air introduced into the bladder in the ordinary working of the instrument as first described, is not of the slightest practical consequence.

Directions for operating, the reservoir having been filled as above shown.—The evacuating catheter having been well oiled and carefully introduced into the bladder, the contained urine is evacuated and six to eight ounces of tepid water are introduced into the bladder. The evacuating catheter is then attached to the evacuator. Gentle pressure of the bulb—sufficient to displace one-third to one-half its contained air—drives a current of water into the bladder and produces the necessary vacuum. The returning current from the bladder brings a portion of its contained water, and with it the calculous débris. This is quietly, quickly, and certainly deposited into the receiver, from which there is no possibility of return into the bladder. Repeating the pressure on the bulb, at intervals of two or three seconds, as long as the fragments are seen to fall into the receiver, the catheter, the point of which has been in contact with the most dependent portion of the bladder, is then withdrawn a little and gently moved about, in order that floating or reluctant fragments may find access to it, and the rhythmic pressure of the bulb is continued until no more débris is seen to fall into the receiver.

If, then, there are evidences that calculous material still remains in the bladder after removal of the evacuating catheter, the crushing is renewed, after which the same operation for removal of the débris is repeated, and so on until the stone is completely removed.

In order to show how completely the débris is removed from the influence of the current which returns to the bladder, a colored solution may be placed in a bottle, the receiver filled to the brim with pure water or glycerine, and attached to the reservoir. Pressure of the bulb drives the colored solution into the reservoir, without materially coloring the water in the receiver, thus showing that the current is between the mouth of the evacuating tube emptying into the reservoir, and that of the independent air-chamber. This places the receiver out of the influence of the current; consequently the débris drops quietly into the receiver and is there retained.